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JUN 13 2020

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Response to Federal Communications Commission Notice of Inquiry
In the Matter of Inquiry Regarding Software Defined Radios
FCC 00-103, ET Docket # 00-47

RED BAT COMMUNICATIONS

REAL-TIME AUCTION AND BROADCAST OF AVAILABLE WIRELESS SPECTRUM

I. OVERVIEW

This response to the Federal Communications Commission's Notice of Inquiry FCC 00-103 (NOI) proposes a market framework that would enable software-defined radios to maximize the economic efficiency of wireless spectrum, particularly for two-way consumer applications.¹ This framework creates a real-time auction mechanism that will enable free market forces to direct the dynamic allocation of spectrum to consumers willing to pay the highest price at any given time or location. Red Bat Communications believes this mechanism will help software-defined (SDR) and software radios (SWR) fulfill their promise by creating an economic environment that efficiently utilizes their powerful technical capabilities. Used in the proposed real-time auction, SDR and SWR handsets will increase the availability of spectrum, improve consumer services and pricing, and help establish the United States as the leading creative and economic force in wireless communications.

II. SPECTRUM MANAGEMENT QUESTIONS POSED BY SOFTWARE DEFINED RADIOS

This response addresses questions posed by paragraph 17 of the NOI. The FCC has proposed several scenarios of spectrum sharing enabled by software defined radios, including short term leases pursuant to contracts, or pursuant to beacon signals broadcast by spectrum owners with available capacity. In his address to the Cellular Telecommunications Industry Association on February 18, 2000, Chairman Kennard also proposed the creation of a web site listing buyers and sellers of wireless spectrum, and the creation of a bandwidth exchange. These proposals would help to lessen, but would not resolve, several significant spectrum ownership, engineering, etiquette and allocation issues created by the use of SDR and SWR handsets:

A. How will radios identify available spectrum?

Frequency scans by the handsets, or negotiations between handsets and spectrum operators would consume significant time and power.

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¹ This proposal is not an optimal solution where economic efficiency is not the primary objective, such as for military use or civil services such as police or emergency channels.

B. What are the conditions of using available spectrum?

In many cases, a spectrum operator² will have made a considerable capital investment in spectrum (license purchased at auction) and equipment (base stations, networks, etc.) to provide wireless communications. Therefore, the opportunity cost of unused spectrum is potentially very large, and spectrum holders clearly have an internal financial incentive to find and implement a mechanism that would allow SDRs to utilize this available frequency, as long as the proposed mechanism does not create new opportunity costs.

C. What is the value of the spectrum? What is the most efficient mechanism for buyers and sellers to arrive at a mutually agreeable price?

This is no small task in the wireless environment. A buyer's perception of the value of wireless, indeed, any, communications is highly subjective and variable. Consumer willingness to pay varies greatly with the time, location, and the information content of the communication. Many calls are price elastic; others, such as emergency calls, are not.

From the seller's perspective, spectrum, or the right to utilize a certain portion of spectrum, represents a constantly expiring good. The unused spectrum cannot be recovered; if the spectrum goes unused, its economic value is lost forever.

D. How will the spectrum holder be able to insure that it receives a fair return on its investment for this frequency? What are the mechanisms for communicating this price to the radio and the consumer? How will the consumer know what the prices are?

E. The radio, and its owner, must then determine in more detail the availability of this spectrum: how long will the spectrum be available? How will the communication be delivered to its final destination? Will the frequency be open long enough to support the desired communication?

III. DYNAMIC ALLOCATION THROUGH A REAL-TIME MARKETPLACE AND AUCTION

Red Bat Communications proposes the development of rules to support a real-time marketplace and auction that will enable spectrum operators to adjust their prices in real-time in response to fluctuations in demand for wireless capacity. In such a system, buyers and sellers of spectrum transact at a centralized exchange, and the results of the transactions are broadcast over a standardized channel. Buyers equipped with SDR and SWR handsets will be able to automatically adjust their purchase and use of wireless communications in response to this pricing mechanism.

Red Bat Communications proposes that the most effective mechanism for dynamic allocation of spectrum to SDRs and SWRs is a form of real-time Dutch auction. In the Dutch auction format, the

² In this paper, Red Bat uses the term "spectrum operators" to indicate spectrum owners or license holders (the current system) and also to refer to a future possibility of open access where entities have the technical capability and license to conduct wireless communications but do not actually own a license to the underlying spectrum. The auction system supports both instances.

seller proposes a price that descends until a buyer emerges; once the initial buyer has completed the transaction, the auction continues until all the product is sold. It is a format ideally suited for markets where multiples of the same product are for sale—like in a Dutch flower auction. The winning bid selects a limited number of “best” flowers from an inventory of thousands, and then the auction continues until no flowers remain. The structure permits different buyers to attribute different subjective values to very similar products, an advantage that is well suited for use in communications.

This dynamic auction format creates a more efficient market for wireless communications, delivering substantial benefits to consumers and carriers by eliminating the considerable amount of deadweight economic loss implicit in the currently dominant subscription model. This greater market efficiency will further aid the rollout of new high-speed wireless data networks by enabling carriers to efficiently allocate spectrum and capital to the highest yield customers.

A. Operation Overview

A spectrum operator will evaluate its available system capacity and issue a set of proposed prices for a geographic region (such as a cell site) based on a standard unit of time (per minute or some increment) or a standard-sized packet of data (per kilobyte) per some time interval.³ In a cellular or PCS system, a carrier will evaluate the current and projected calls flowing through the cells in its network, and issue a set of higher prices for cells that are near capacity, and lower prices for cells experiencing lower demand. Qualified third parties may also participate, if they have purchased a wireless “future” through a wireless bandwidth exchange, and will similarly look at current demand and pricing in order to establish a price that they believe will be accepted by the wireless market. The spectrum operators and qualified third parties are collectively known as “sellers”. These prices and other associated information (control channel frequency, standards used, etc.) will be transmitted to the auction entity, preferably in real time via a secure network.

The auction entity will record, code, and consolidate all offers from multiple sellers by time and geography. This entity will then broadcast the consolidated pricing information in the appropriate geographical location in a repeating data loop, similar to a stock market “ticker”.

Two-way wireless (SDR and SWR) handsets and data devices will contain software which constantly monitors the auction broadcast for price and other service information. This software will also help consumers determine and establish their operating preferences, such as pricing thresholds and quality requirements. For example, a consumer may indicate that he or she does not want to pay more than \$.10 per minute for a call; when the price is less than \$.10, the handset will automatically place the call, but if it rises above \$.10, the consumer will need to manually intervene to accept the higher price. This decentralized decisionmaking capability will create massive opportunities for new services, consumer customization, and consumer control of their spending on wireless communications.

When the consumer begins to place a call, the auction-enabling software will match the broadcast information (prices) with user-defined parameters to select the optimal spectrum seller. Using information from the auction broadcast, the handset will quickly switch to the control channel for the selected spectrum seller. This same broadcast will also identify where the SDR or SWR handset could download the software necessary for operating on the selected spectrum. With

³ In the long run, pricing based on a set number of bits per some increment of time will provide strong economic incentives for both voice and data services.

appropriate spectrum capacity, the auction entity could also provide in its broadcast any software necessary for operating on the selected spectrum through a repeating data loop, achieving additional spectrum efficiency if multiple operators use the same basic software.

After acquiring the spectrum operator's control channel, the handsets will register (provide identification and billing information) and request spectrum or code assignment. In a PCS or cellular frequency, the handset may simply register as a roamer, following standard industry procedures and techniques. This registration process will implicitly indicate that the consumer has committed to purchase the spectrum at the price transmitted through the auction's information broadcast. The registration process itself serves as a "buy" order. This method minimizes the spectrum overhead committed to "negotiation": the buyer either accepts the price and the implicit conditions of use or does not. This technique reduces operational complexity and transaction costs for both the buyer and the seller, and can be implemented rapidly in existing systems.

Any payment system will require confirmation with a trusted third-party intermediary, whether that intermediary is a wireless service carrier offering additional value-added services or simply a credit card company that offers validation. In a cellular or PCS system, the handset's identification codes will indicate its "home" system, and the spectrum operator will utilize the wireless intelligent network (or in the future, secure Internet connections) to confirm the buyer's good financial standing, to prevent fraud, to register the handset's location for incoming calls, and to offer other value-added services.

In the future, the "home" system will not need to be a cellular or PCS operator. An independent third party could operate its own SCP/HLR/validation servers and operate as a "virtual" carrier, one that does not own spectrum but provides other services to the wireless consumer. Internet portals are one possibility; credit card companies are another. Each could offer a range of new services in addition to the basic functions necessary to implement wireless communications, thus stimulating innovation and competition.

After the call is completed, the spectrum operator will transmit the call's duration and location to the auction entity. The auction entity will "rate" the call by correlating the call's time, location, and duration with the prices issued by the carrier for that time and location. (Alternatively, the spectrum operator could also "rate" the call, and the auction entity will validate the price.) The methodology supports a variety of other possibilities. In advanced implementations, the handset itself could also transmit its call information (location, duration, and price) and the auction entity will match this record against the spectrum operator's. Or the entire transaction could occur in real-time; using the wireless intelligent network, the consumer's "home" system could support a prepaid service and enable real-time monitoring, billing, and payment. The auction entity is ideally situated to serve as a low-cost, neutral intermediary for any payment methodology, enabling both the buyer and seller to have trust in the transaction—without extensive and expensive regulatory oversight.

B. Technical and Economic Advantages of the System

A single one-way broadcast structure for transmitting the results of the auction or exchange to handsets provides multiple technical and economic advantages:

1. Reduces Search Costs for Finding Available Spectrum

The auction mechanism reduces search costs for handsets (or carriers) seeking available capacity, delivering significant technical and economic benefits. On the technical side, the lower search costs reduce time spent searching, handset power consumption, and the quantity of spectrum devoted to overhead and negotiation with base stations and other wireless devices. Faster searches and set-ups are particularly critical in a market where supply and demand change every second, and enabling a rapid search will allow the system to achieve a much finer time and geographic granularity, resulting in efficient spectrum allocation, even, perhaps, down to the second.

The economic benefits of a rapid and complete search are also substantial. One, lower search costs result in reduced transaction costs, increasing activity and market liquidity. Two, cheaper and more complete searches reduce the probability of imperfect information, which, in turn helps eliminate market imperfections that result in inefficient spectrum use. Three, the single auction broadcast provides a signaling mechanism by which spectrum holders may learn in real time what the other spectrum operators are charging for the same service, and thereby obtain additional information on overall demand in the marketplace.

2. Creates Independent and Neutral Market Intermediary

The use of an independent and neutral auction mechanism protects and serves both sellers and buyers. As a neutral intermediary deriving revenue from each transaction, rather than the actual capacity, the auction operator would have strong incentives to represent prices accurately to both the buyer and the seller. The auction operator serves as a neutral and trusted third-party intermediary who will be responsible for insuring that the consumers are charged the price that was quoted by the seller.⁴ On the other side of the transaction, the auction intermediary provides a mechanism to help prevent fraud by consumers. For both buyers and sellers, the existence of a neutral intermediary will document transactions and resolve disputes.

3. Minimizes Spectrum Consumption

The single, one way broadcast enables one limited information broadcast to support an infinite number of users. Two-way systems involving query and response, or systems that propose a negotiation between buyer and seller, will consume far greater quantities of spectrum just to establish the price and contract structure. As the number of wireless consumers grows, two-way structures will end up consuming more and more bandwidth devoted to overhead functions such as call set-up and terms-of-use negotiation.

⁴ A proposal where the carrier or spectrum holder "advertises" its prices on its control channel would need to have very strong regulatory oversight to prevent slamming. Only strong regulatory oversight would prevent spectrum holders from "advertising" one fee but charging another, including tacking on hidden post-call charges. This method would require an ongoing regulatory effort, one of increasing complexity as the number of consumers and sellers grows.

4. Provides Constant Error Correction and Updates

The repeating broadcast mechanism simultaneously provides constant error correction through repetition and real-time pricing updates.

5. Provides Standardization Mechanism for SDRs and SWRs

The auction entity and broadcast structure will provide a convenient and efficient gateway for updating the base standards of software defined and software radios. A standards body or regulatory agency could utilize this auction mechanism to periodically and efficiently update millions of wireless handsets and data devices.

IV. ADVANTAGES OF THE PROPOSED AUCTION'S STRUCTURE

A. Public Benefits

1. Promotes use of unused frequency ("micro level")

The proposed auction mechanism will provide incentives and mechanisms to place open spectrum into use down to a very fine granularity of time and geography. Spectrum holders will be able to cheaply and rapidly implement a yield management type of system for their spectrum, similar to those common in the airline and hospitality industries. In periods of slack demand, spectrum holders could reduce their prices to stimulate use. In times and regions where demand fills available capacity, spectrum holders could raise prices.

This will benefit sellers and buyers alike. Spectrum holders will be able to maximize the return on their investment when demand exceeds supply. Consumers will benefit as channels are allocated to those who value the spectrum most at that particular instant and location.

This mechanism provides a free market solution to the problem of assigning priority channel allocation. It is far simpler and more equitable than other possible solutions, such as those based on a subscriber's total monthly buckets of minutes, which would exclude low-use consumers even though their call might be more important at that particular instant. Moreover, it would provide consumers with access to all available spectrum, rather than just the spectrum owned by one operator, thereby increasing the probability that the consumer will be able to find a suitable channel at a decent price. Finally, with software defined radios, the consumer may be able to trade quality for cost, thereby increasing the probability of completing a call, although at the expense of some call quality. (See Consumer Benefits)

2. Promotes spectrum efficiency ("macro level")

In the current wireless PCS and cellular market, some spectrum is underutilized because the spectrum holders do not have the marketing capability to attract users to their systems and

networks. Small, regional spectrum holders, in addition to paying for their spectrum, must also build-out their networks and establish a brand name; these are difficult and costly tasks, particularly when engaged in competition with large entities that have nationwide coverage and powerful brand names established decades earlier. The auction mechanism will enable these spectrum holders to rapidly increase the utilization of their spectrum without absorbing massive marketing and acquisition costs.

3. Improves spectrum usage

The free market of the auction mechanism will encourage consumers to make more efficient use of spectrum through decisionmaking based at least in part on the direct price of the call at the time. Consumers will use the auction-enabling software in their SDR handsets to reserve their peak use for the most important calls. Trivial messages and emails will wait until prices fall, and making unimportant calls will be delayed. It is a free market solution to avoid the tragedy of the commons, where everyone had equal access but the economic yield of the common declined.⁵

4. Promotes investment in technology to increase capacity

License holders have powerful and direct financial incentives to upgrade and improve their radio equipment, since investments to improve spectrum efficiency will increase their financial return and market position -- regardless of marketing ability. The auction structure could provide incentives for cellular and PCS operators to increase the density of their cell sites in high-traffic areas; it will also provide these spectrum holders with a powerful mechanism for estimating the usage and potential return from undertaking such investments.

Flat rate pricing structures do not directly reward investment in creating new capacity through new cell sites; the mechanism is indirect, at best, as carriers must add capacity in order to avoid annoying and losing their customers.

5. Supports technological investment and innovation

As software radios improve, spectrum holders and operators will be able to improve their competitive position by implementing more efficient algorithms. Spectrum holders with more efficient algorithms will be able to carry more communications in a fixed band of spectrum on a fixed set of equipment, thereby increasing productivity and creating a competitive advantage. The use of the auction structure in conjunction with SDR and SWR handsets will create an environment that encourages innovation in the development and implementation of new "standards" and algorithms. This secondary effect may unleash spectacular new innovations and uses for wireless communications that are not yet contemplated.

⁵ Flat rate wireless calling plans help relieve consumer confusion and concern about what rates they will be charged, and have been extremely successful at attracting subscribers. But flat prices do not translate to spectrum efficiency. At peak times, when users most value their communications, the flat rate represents a price where demand severely outstrips supply. Conversely, this flat rate is too high during periods of low demand, so massive quantities of spectrum lie dormant. The Red Bat proposal offers a mechanism where consumers will still know what they are being charged, and will still be able to implement a plan that is very similar to the flat rate pricing structure, yet allows far more efficient use of spectrum.

6. Promotes consumer adoption of SDR and SWR handsets

Competition and the auction structure will enable the most advanced SDR/SWRs to obtain the lowest-cost spectrum or the most advanced services. Just as the auction structure directly rewards efficient spectrum use and investment by spectrum operators, it also promotes and rewards consumer investment in SDR/SWRs that will make the most efficient use of spectrum.

And with software-radio base stations, older standards could still be supported upon request from the handsets, although presumably the lower efficiency of the “old” digital radio and software-defined radios would cost more than the airtime for the newer and more efficient software radios using the most advanced algorithms. This provides free market incentives for consumers to upgrade their handsets, without forcing the consumers to change handsets by threatening to instantly obsolete the interface standards.

The proposed auction will support all handset technologies, but it provides a free market structure that will create competitive advantages and higher rates of return for spectrum users (spectrum operators *and* consumers) who make the most efficient use of spectrum. This will create a natural, self-interested migration from the current technology to the full future potential of digital wireless radios.

7. Creates Market Liquidity

Through this auction, holders of capacity (carriers, investors or other third parties who have purchased bandwidth through a futures exchange) will be able to liquidate their wireless bandwidth assets instantly, for the best possible price. Third parties, such as commodities investors or advertisers, will be able to invest in wireless bandwidth and, through the auction, utilize a mechanism for selling their holdings directly to end-use consumers, thereby obtaining a means of achieving instant and final liquidity. New entrants—such as advertisers—could purchase capacity and offer free wireless service in exchange for looking at an advertisement.

8. Attracts Increased Capital

Reducing transaction costs and creating market liquidity will attract more capital and new uses. Spectrum holders struggling to build-out or upgrade their networks could raise capital by selling long-term bandwidth futures to investors. These investors could either resell this capacity to another party, or hold the asset as an investment vehicle before finally selling the capacity directly to end-use consumers without incurring the extremely high transaction costs of actually developing a subscriber base.

9. Penetrates Low-Use Market Segments

The FCC has undertaken many efforts to support wireless communications as a public safety device. The anytime, anywhere capabilities of wireless communications is an immense opportunity to enhance public safety—but only if all consumer groups have access to wireless communications. In addition, wireless telecommunications -- including wireless web access --

will become a crucial technology of the “digital divide”.

The auction mechanism will deliver wireless communications to a market segment that carriers cannot profitably target, and so will not serve. In the current cellular and PCS market, carriers have a difficult time generating a return on the low-use, low-income market segments. One, high marketing costs and giveaway programs increase customer acquisition costs. Two, these costs must be recouped through higher per minute rates, driving down usage among low-income segments. Three, price-sensitive consumers are more likely to churn as they seek better prices and deals, making it even more difficult for carriers to profitably acquire high-churn, low-use subscribers.

The auction proposal would bring these consumers into wireless communications, and provide a mechanism where they are able to economically utilize all the potential of wireless communications. One, the auction mechanism enables spectrum holders and operators to sell directly to end-use consumers, eliminating high acquisition costs. Churn is irrelevant, because the acquisition costs for the spectrum operators are zero. Two, the remaining acquisition costs (providing a home system and billing mechanism) may be absorbed by third-party entities, “virtual carriers” who provide entry into wireless communications in order to drive other business models. Credit card companies, for example, may offer a “home” service in order to attract additional billing; Internet portals may offer the same service in order to draw in viewers to increase advertising revenue. Advertisers may purchase and distribute free handsets and minutes in order to promote other, non-wireless services.

Low-use or low-income consumers may wish to place high-value wireless calls. Some individuals may make only a few calls per month, but they might be willing to pay a higher price for these individual calls depending on who they are calling, at what time of day, and the purpose of the call. The auction provides a more efficient mechanism for enabling these consumers to access wireless service. Indeed, the auction creates several opportunities for the free market to extend wireless communications to low-income consumer segments. One, low-income callers with auction-enabled software-defined radio handsets could wait to make their calls until the price falls to an acceptable level-- and the consumer would still have the wireless handset and the capability to make emergency calls. Two, the smooth entry of third-parties (such as advertisers) who will use wireless communications to drive other business models may support the distribution of “free” handsets and provide “free” calls in exchange for accepting advertising.

10. Promotes the United States as the World Wireless Leader and Incubator

The integrated operation of software-defined radios and a real-time auction structure will promote the development of new services and software that will aid the United States role as the key technology innovator in wireless and Internet applications. As more spectrum is opened, and prices are dynamically matched to those who will use this spectrum efficiently, the wireless industry and wireless Internet could become one of the critical engines of economic growth in the next decade.

B. Benefits to Consumers

1. Improves Customization and Control of Handsets and Pricing Plans

Auction-enabling software in the handsets will enable the consumer to customize and control their expenditures on wireless communications in powerful new ways. At the same time, this improvement in customization will also reduce the costs and the complexity of carrier's rating and billing operations.

Simple to use software could allow the consumer to establish cost and operating parameters, plus indicate any carrier or other service preferences. For example, the consumer may establish a parameter where the handset only completes calls if the cost is less than \$.10 a minute; calls above this rate would require a manual override. This allows the consumer to quickly make calls in a dynamic pricing environment while still protecting the consumer against higher-than-desired prices. Already, new wireless handsets enable consumers to keep track of the number of minutes consumed per some time period (month); by integrating this feature with the auction-pricing system, consumers could easily keep track of their spending per unit of time—by day, week, or month.

The possibilities are limitless. A consumer could indicate a preference for a particular carrier: where the carrier is available, the handset will automatically use that carrier's network, otherwise the spectrum will be purchased by the handset "at auction". In addition, the carrier preference may be conditional: as long as that carrier's price is below a certain price per minute, the handset uses that carrier; otherwise the handset seeks the lowest cost provider. Another subset of options would allow the consumer to identify a threshold price for different individuals in her address book. This may be extended to cover emails as well. Corporations will be able to control costs by exercising very detailed control over wireless spending, down to the individual, time, and geography by defining the operating parameters of the handset.

2. Improves Quality

By defining the basic trading unit in terms of a set number of bits per unit time, the auction system could allow consumers to arbitrarily increase the quality of their calls by increasing the data transmit/receive rate of their handsets (while holding power constant). PDA owners could use the same mechanism to increase the speed of their downloads when necessary. With software radios, this adjustment could occur in real time, in the midst of an ongoing communication, if so desired. In each instance, the decisionmaking resides in the hands of the consumer, yet the auction mechanism allows smooth and efficient use of spectrum while delivering the best possible return to the spectrum operator. Of course, the price of this capacity and the cost of the transmission would be easily displayed on the handset's screen.

3. Allocates open channels according to call priority

Available spectrum will be allocated to the individuals who value the spectrum the highest at that particular time and location. This provides a simple and free market solution to the problem of allocating channels in times and regions where demand outstrips the supply of

channels.

Under the current model, virtually all consumers have an equal probability of obtaining an available channel, irrespective of the relative importance of the call. A person ordering a pizza has an equal probability of obtaining an open channel as a businessman closing a valuable deal or a victim calling 911.

Granting priority to callers with higher monthly usage (frequent callers) through a prioritization algorithm is one possible solution, but it is problematic. At any given instant, some low-use subscribers may value the spectrum more and be willing to pay more than high-use subscribers to place a call. An allocation mechanism that bases priority based on monthly use would divert resources to the individual who valued the spectrum less at that particular instant. This would represent an economic loss to both the consumer and the spectrum seller, who will have missed the opportunity to maximize its revenue from that particular slice of spectrum.

The auction creates an open channel for those consumers who value the spectrum the most at that particular instant. In addition, it provides the consumer with access to the entire expanse of spectrum rather than just the frequency band of the subscriber's home network.

C. Benefits to Spectrum Operators and Licensees

1. Maximizes Revenue, Captures True Benefits of Capacity

Red Bat's auction proposal will enable spectrum holders and operators to implement a yield-management system similar to those found in the airline and hotel industries. Unused spectrum is the same as inventory that has expired; any spectrum that goes unused is virtually the same as an empty seat on an airplane that has just left the gate. This auction allows spectrum holders to place unused spectrum immediately into use -- as long as the price is greater than the marginal cost of the call, the seller will generate additional profit. In addition, the spectrum holder is able to maximize revenue when demand is greater than capacity by raising prices. Under a flat rate plan, demand that exceeds supply represents a lost revenue opportunity because the spectrum holder cannot provide enough capacity to conduct the transaction. The auction system captures that lost revenue.

By eliminating substantial amounts of deadweight economic loss, this auction creates market incentives and advantages for those carriers who devote resources to network technology rather than huge marketing campaigns. This auction will help smaller or regional PCS license holders, or any licensees that do not have the nationwide coverage or marketing capability, to attract users to their systems. The auction mechanism will enable these companies to increase the utilization of their spectrum without absorbing the massive marketing and customer acquisition costs necessary to build a subscriber base.

2. Increases Utilization of Capacity

Spectrum operators may adjust their prices to stimulate demand for unused capacity. Any capacity sold at a price greater than marginal cost is new profit. In addition, higher capacity

utilization will reduce the average cost of service, creating the opportunity for greater pricing flexibility.

3. Allows Peak Pricing at Peak Periods

Spectrum operators also benefit from dynamically adjusting their prices upwards during peak periods. This is especially valuable when demand exceeds supply, because it enables sellers to use simple economics rather than heavy processing power and engineering to allocate scarce spectrum to those consumers who consider it the most valuable at that time and location.

4. Increases Wireless Consumer Base

The auction mechanism will increase the base of wireless consumers and devices at an even faster pace than the industry is already experiencing. The increased control and customization will increase the trust in wireless service, and provide a means for lower income market segments to obtain and utilize wireless spectrum for a variety of communications applications.

The auction mechanism will deliver wireless communications to a market segment that carriers cannot profitably target. The auction proposition will prove most attractive to low-end, low-use subscribers whose calling patterns are inconsistent, unpredictable, or flexible enough to allow real-time adjustments to their calling patterns. Business users with less price sensitivity will continue to find more value in a subscription to a nationwide flat rate plan, though in some times and locations, even these subscribers and their carriers may find that the auction delivers substantial value.

5. Increases Consumer Use of Wireless Services

The recent explosion of wireline bandwidth consumption demonstrates a very high elasticity of demand for data communications; the same should be true for wireless communications, particularly because wireless offers the advantage that it can provide communications anytime, anywhere. The consumer does not need to be tethered to a desk or a fixed location in order to communicate. The improved economic efficiency of the auction proposal will result in a rapid expansion in the number of wireless minutes consumed per consumer.

6. Allows Improved Pricing Models for Data

Dynamic pricing and outsourcing the rating process to consumer's handsets will significantly aid a carrier's development and pricing of wireless data services. One significant problem currently facing carriers is the question of how to price data services; clearly each circuit or packet devoted to transporting data must reflect the opportunity cost of an additional voice call that could have been carried in that same spectrum. As in wireline communications, pricing wireless data services at voice prices will prove to be prohibitively expensive for most consumers and applications.

The auction proposal relieves much of this problem. The auction-enabling software in the consumer's handsets will monitor the changing prices and send or receive data when the prices fall to a level deemed acceptable by the consumer. This shifts the decisionmaking and

processing requirements from a carrier's centralized databases and rate structure to the individual handset, enabling lower costs, greater accuracy, improved overall spectrum efficiency, and richer suites of services and applications.

7. Enables Improved Service

The auction system will provide spectrum holders and wireless carriers with other new service and revenue opportunities. For example, a "traditional" wireless subscriber trying to obtain an open channel on the home network during a period of peak demand may be denied, increasing consumer frustration and the probability of future churn. An auction-enabled handset, however, could automatically seek out and utilize the spectrum of another carrier until the home network again becomes available. If the cost of this spectrum is less than the rate charged by the home carrier's subscription, then the carrier has captured revenue that would have been lost. Even if the spectrum costs more than the subscription rate, and the carrier absorbs the difference, it has increased customer satisfaction. The same mechanism also allows carriers to market a service that virtually "guarantees" that the consumer will never be denied an open channel.

IV. RECOMMENDATIONS

Red Bat Communications proposes a marketplace framework which achieves spectrum efficiency and the other benefits described above with little need for changes to the current regulatory scheme. Existing auction, roaming and ownership rules would require minimal amendment to support the auction system, allowing for consistency and avoiding regulatory burden and accompanying costs. To support the creation of the marketplace/auction, Red Bat suggests that the FCC:

1. Allocate Frequency or Issue a License for a Standard Control Channel

The FCC should issue a license for a standard frequency for the control channel in all areas in order to increase the efficiency of the market, by enabling manufacturers of software defined radios and roaming consumers efficient access of the real-time auction and bandwidth exchange. Alternatively, if such frequency is unavailable, develop a set of rules that will allow the information broadcasts to be delivered through existing wireless systems, such as the unused capacity of a cellular control channel.

2. Adapt Rulemaking to Support Roaming SDR and SWR handsets

The FCC should adapt and apply rulemaking from the cellular business to the entire available spectrum. Operators auctioning capacity must allow all "roamers"—software defined radios or other "non-subscribers" who are in good standing -- to utilize their capacity.

The FCC should support rule making supporting a uniform rate mechanism for the bandwidth exchange. All charges must be rolled into the price established auction: carriers cannot install hidden charges outside the price of the auction, including taxes, etc. This simplification will also simplify software in the handsets, and will insure price transparency that will aid consumers. If hidden charges exist, consumers will suffer the consequences, and spectrum will

not be efficiently allocated by the market. The use of the one-way broadcast is also highly spectrum efficient; other methods that require “negotiation” or an exchange of information between the buyer and seller before a commitment to purchase is made will consume bandwidth, adding to the overhead and congestion on already-saturated spectrum.

3. Develop rules supporting “Virtual Carriers”

The FCC should develop rules supporting the development of “virtual carriers”—entities with SCP/HLR functions and billing capabilities but no wireless spectrum. The FCC should also modify resale rules to allow more direct interconnections with spectrum operators in order to facilitate the development of new entrants and services.

In conclusion, Red Bat Communications proposes a marketplace framework which promotes the benefits of software defined radios and provides significant benefits to the providers and consumers of wireless communications, but requires minimal regulatory changes or oversight.

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